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FATAL INFECTION BY A HITHERTO UNDESCRIBED
CHROMOGENIC BACTERIUM, *BACILLUS AUREUS*
FOETIDUS.*

MAXIMILIAN HERZOG,
Manila, P. I.

(*From the Government Biological Laboratory, Manila, P. I.*)

THE fauna and flora of the tropics being in general different from that of the more temperate latitudes, in genera as well as in species, we may reasonably expect that this observation will hold good also with reference to the very lowest forms of life—bacteria and protozoa—without, however, being unmindful of the fact that certain families and even species are distributed over an enormous territory under the most varied conditions of life.

We can hardly expect to find that those bacteria and protozoa which are strict parasites of widely distributed races are limited in area, unless it be that they depend in certain stages of their life-cycle upon an intermediate host, itself confined to certain areas. To cite an example: The tubercle bacillus is found practically wherever an easily susceptible host of this parasite—like the human being—dwells. *Hemameba malariae*—likewise a parasite of man—is not so widely distributed, because it depends for its dissemination upon an intermediate host—the anopheles, the distribution of which is not identical with that of man.

The *a priori* deduction that we shall find in the tropics certain bacteria and protozoa peculiar to this zone is therefore limited to those bacteria and protozoa which are either strictly saprophytic or parasitic in certain hosts, confined to the tropics themselves, or which only occasionally and under particularly favorable circumstances lead a parasitic life.

The observation to be recorded in this paper refers to a case of fatal human infection by a hitherto undescribed bacterium, which is evidently not very pathogenic in ordinary conditions and as a rule is probably a harmless saprophyte, which, however, in

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circumstances especially favorable, as in this instance, may become parasitic and cause a fatal issue. Examples of this type are of course not unknown in clinical medicine. The colon bacillus, usually a harmless saprophyte, living in the intestinal contents, occasionally invades the fluids and tissues of the human body and leads to acute or chronic fatal infections.

The case to be reported is as follows:

On February 19, 1904, the body of D. L., a Filipino, 40 years of age, was sent to the morgue at San Lazaro. All that was known about the case was that the person had died rather suddenly, and it was suspected that he had died of plague, having an open wound on his right leg, and a marked swelling of the inguinal glands of the right side. The postmortem examination was made eight hours after death. The findings were in short as follows:

The body of a well-developed man, about 40 to 45 years of age. Post-mortem rigidity well marked; lividity well marked on dependent parts of the body, and extending somewhat toward the sides of the neck and throat. There is a swelling of the size of a hazelnut, firm and elastic, in the right inguinal region. There is no fluctuation and no edema in the neighborhood. The skin is intact over this area and of normal color. In the right popliteal space there is an ulcerated surface $5 \times 1\frac{1}{2}$ cm. in size, the long diameter being in the long axis of the limb. The ulceration is several millimeters deep, has sharp, somewhat raised edges, and the granular surface is covered with a small amount of sero-fibrinous exudate; iodoform has been dusted freely on the wound. The condition of the ulcer suggests that the surface has recently been curetted and its edges trimmed.

The serous membranes are shining and transparent. There is a very small amount of serous fluid in the thoracic and abdominal cavities. Hemorrhagic spots are not found anywhere. The pericardium, and the heart and large vessels appear normal. The lungs are slightly hyperemic, otherwise normal; bronchi, trachea, and larynx normal; epiglottis slightly injected.

Spleen normal in size, consistency, and color; trabeculae a little more marked than usual.

The kidneys show a marked injection and are of a deep pinkish-purple hue. The capsule is smooth, even, and transparent, and peels off easily. The surface appears slightly granular. The glomeruli are strongly injected and surrounded by a much paler, somewhat grayish-white tissue. The pyramids are likewise of a deep, pinkish-purple color. The relation between cortex and medulla is normal. The mucous membrane of the pelvis is smooth and shining. Suprarenals normal.

The liver is normal in size and rather firm in consistency. Capsule is smooth and transparent, except that on the upper surface are a few small, irregular, dull, slightly raised perihepatic areas. On section the color is brownish, the centers of the lobules being rather grayish-white.

The gall bladder is normal and contains a moderate amount of turbid, greenish-yellow bile; no stones. The pancreas is perhaps somewhat firmer in consistency than usual, otherwise normal.

Stomach and small intestines: mucosa slightly congested, otherwise normal. Large intestine and appendix are normal.

Three of the inguinal glands of the right side are enlarged to twice their normal size in all their diameters. On the left side they are slightly enlarged. The glands of the right side are quite firm in consistency, not injected, and rather pale. The cervical glands are slightly enlarged and moderately congested.

Smears from the organs show a small number of what appears to be a small diplococcus or diplobacillus. There are no organisms found showing the characteristic morphology and staining properties of the plague bacillus.

It was therefore decided—a decision having to be made shortly after the postmortem examination in order to determine the course to be taken as to the body and the house from which it came—that the case was not one of plague infection.

The anatomical diagnosis reads as follows:

Passive congestion of the kidneys and liver. Acute interstitial hepatitis. Enlargement of the inguinal and cervical glands.

Cause of death: Remote, iodoform poisoning (?); immediate, terminal diplococcus infection.

It may be stated that inquiries as to the history of the case and as to the possibility of iodoform poisoning were made. As usual in the case of the lower class of Filipinos, only a very fragmentary, unsatisfactory history could be obtained. Dr. Christensen, health inspector of the district from which the body was sent for postmortem examination and diagnosis, had never seen the deceased alive, but learned that he had not been perfectly well for about four months, that he had had an open wound on his leg, and that iodoform had been used freely on it for about eight days. No history of any symptoms of iodoform poisoning could be obtained. The liver was examined for iodine in the chemical laboratory, but no iodine could be found.

DESCRIPTION OF THE BACILLUS ISOLATED.

During the postmortem examination glycerin agar tubes were inoculated with the usual precautions.

Two tubes inoculated from the liver developed pure cultures of a short, small bacillus, which produced a golden yellow pigment.

One tube from the heart's blood developed the same organism, but it was, as shown on the third day, contaminated.

One tube inoculated from the spleen remained permanently sterile. None of the tubes developed the plague bacillus.

Morphology.—Short bacilli with rounded ends, varying much in size. They are from 0.6μ to 2μ long; on an average 1.4μ long. The larger individuals of 2μ are rather scarce. In thickness the bacilli vary from 0.55μ to 0.8μ . Proportion of length to thickness usually 2:1. The organism presents itself frequently as a diplobacillus. A large number of them are short, making them look much like diplococci. Occasionally there are found small individuals which are not materially larger than 0.5μ and almost spherical, so that it is hard to distinguish them from true diplococci. The bacilli possess a capsule of moderate size, which can be demonstrated by Muir's method. They do not form large chains, even groups of four in a chain being but rarely seen. Spore formation is not observed. The organism is not motile.

Staining properties.—The bacilli are readily stained by the watery aniline stains and easily overstained by the more intense solutions (carbol-fuchsin, carbol-thionin). When lightly stained, not all of the bacilli take the stain uniformly; but in some cases the stain acts in such a manner that an unstained space remains in the center. It is not demonstrable that this polar staining is due to the presence of Ernst-Babes polar granules, because Neisser's methylene blue Bismark brown stain does not show any such granules satisfactorily, though there appears to be a slight tendency at the poles of the bacillus to take up some of the blue stain. The bacillus resembles somewhat the short type of the pseudodiphtheria bacillus. A certain similarity also exists between this bacillus and that of plague, though the similarity is not great. Gram's method decolorizes the bacillus.

Cultural peculiarities.—The organism produces on all solid media tried an intense golden-yellow pigment, which is practically identical in color with the pigment formed by *Staphylococcus pyogenes aureus*. Distinct colonies in 20 per cent. gelatin plates are quite difficult to obtain, because the organism liquefies the gelatin with great rapidity. Twenty per cent. gelatin stab cultures after 24 hours are fluidified largely. The liquefaction comprises the entire extent of the upper strata. There is some growth along the line of the stab, but not much. The liquefied gelatin looks very cloudy and after 24 hours a dense scum is formed on its surface. Individual colonies are best studied on agar plates. On agar and glycerin agar the organism after 24 hours forms a moist, raised, golden-yellow growth. The individual colonies are more or less round and likewise moist and raised, with a somewhat undulating surface. The margins are smooth. In spreading, the colonies become confluent. The development on glucose agar is identical with that on ordinary agar. No gas formation occurs. On three per cent.

salt agar the growth is possibly a little slower, although not very much so. The bacilli raised on this medium stain as usual, and do not show the involution forms so characteristic of the plague bacillus. On lactose agar the growth is similar to that on the other agars. There is no gas formation. The development on the surface is more rapid than in the depth of the stab. In lactose litmus agar the color begins to turn after 24 hours and is quite distinctly red after 48 hours. Broth after 24 hours is strongly clouded, and after 48 hours a pellicle has been formed on the surface. On potatoes a typical luxuriant growth is observed after 24 hours. Litmus milk is slightly reddened after 24 hours, and is strongly so after 48 hours. Coagulation takes place only at the end of several days. The organisms develop typically under anaërobic conditions in both a nitrogen and a hydrogen atmosphere. All cultures whether aërobic or anaërobic have a fetid, cheesy, and somewhat cadaverous smell.

The thermal death-point of the organism was determined to be 62° C. An exposure of ten minutes at this temperature destroyed all the bacilli, while 61° C. acting for ten minutes left a number alive.

The name "*Bacillus aureus foetidus*" selected for this micro-organism emphasizes two of its prominent characters—its chromogenic and malodorous properties.

PATHOLOGICAL HISTOLOGY.

Pieces of tissues were placed in Zenker's solution, imbedded in paraffin and stained with hematoxylin eosin, eosin alkaline methylene blue, and by Gram's method.

Liver.—The boundaries of the lobules are well marked, since the interlobular veins are surrounded by an inflammatory cellular infiltration. In quite a few places this inflammatory process must have been going on for some time, since here the interlobular tissues show a number of fusiform connective tissue cells and fibers. When examined with the immersion lens, it is seen that the cellular exudate consists mainly of small round cells of the lymphoid type; here and there a plasma cell is seen. Quite a number of the small round cells show karyokinetic figures, demonstrating that a lively proliferation has been going on in the inflammatory foci. The latter contain a considerable number of small bacilli found in irregular groups, in groups of two, and in small chains. This micro-organism does not generally stain very well, even in methylene blue. Some, however, keep the dye fairly well.

The liver cells show a marked, though not advanced, degree of fatty change. This process is perhaps most marked in the center of the lobule; though it may be quite diffusely distributed in places. The liver capillaries are congested.

Kidneys.—The majority of the glomeruli appear normal; some, however, show an increase in the nuclei of the endothelial lining of the glomerular capillaries, while in others there is a more or less marked thickening of the capsules of Bowman. We also see beginning fibrosis in the interior of the tufts, and there may be a complete obliteration of the capillaries. In the

neighborhood of such glomeruli as show more or less advanced changes and between the convoluted tubules, are inflammatory foci. *These foci consist mostly of small round cells of the lymphoid type.* There are present, however, some plasma cells and plasma "mast cells," and a considerable number of eosinophilic polynuclears. These foci likewise show the small, generally poorly stained bacilli. The epithelial cells lining the uriniferous tubules show cloudy swelling or vacuolation, with loss of the nucleus. Most tubules contain a granular material, some contain hyaline casts. The renal blood vessels are all densely filled with blood.

Neither the liver nor the kidneys show any areas of marked coagulation necrosis; nor are areas of blood extravasation encountered.

Lymph glands.—The inguinal lymph nodes show a marked increase in fibrous connective tissue in the capsule, in the trabeculae, and around the individual blood vessels. The follicles themselves, however, show no marked fibroid changes, and the differentiation between the peripheral zone and the central proliferating center is well preserved. Karyokinetic figures are seen here and there in the proliferating center. Occasionally an eosinophilic polynuclear is encountered. Plasma cells and plasma "mast cells" are also seen. Bacilli like those found in the liver and kidneys are present, forming little groups here and there among the cells. The blood-vessels of the lymph nodes are generally well filled.

No changes are found in the lungs. The pancreas is normal except for slight increase in the interlobular connective tissue.

The myocardium shows some fragmentation, brown atrophy, and fatty changes.

ANIMAL EXPERIMENTS.

February 26, 1904, a small monkey (*Macacus philippiniensis*) was given an intraperitoneal injection of two to three c.c. of a 24-hour broth culture of the bacillus. There was only a slight reaction, and the animal was well at the end of one month.

March 1, 1904, a good-sized, full-grown rabbit was given an intraperitoneal injection of two to three c.c. of an emulsion of a two-days' agar culture in sterile water. The result negative.

A negative result was obtained in a half-grown wild gray rat inoculated subcutaneously with a platinum-loop of a fresh agar growth.

It appears from these animal experiments that *Bacillus aureus foetidus* is not highly pathogenic.

CONCLUSIONS.

Beyond doubt, *Bacillus aureus foetidus*, the bacterium now described, was the cause of death in the case here reported. Experiments show that the bacillus is not a highly pathogenic microorganism, because single inoculations of moderate doses brought about only slight reaction in the animals experimented

upon. Perhaps inoculations repeated during a longer period might bring about more serious result.

It is probable that *Bacillus aureus foetidus* is ordinarily a saprophyte. In the case reported it may simply have lived for some time in the necrotic tissues of a neglected ulcer, and may have become modified in this environment until it finally gained entrance into the juices and tissues of the patient. From the lymphatic system it entered the blood current, reached the liver and kidneys, and led to subacute and somewhat chronic interstitial fibroid processes and parenchymatous degenerations. To the anatomical diagnosis made at the postmortem table must be added, as shown by microscopic examination: Beginning interstitial and marked parenchymatous nephritis, as well as beginning, though slight, brown atrophy and fatty degeneration of the myocardium.